

## GERALD GENTLEMAN STATION UNITS 1&amp;2

## FLUE GAS DESULFURIZATION SYSTEMS

**SECTION 233400****HVAC FANS****PART 1 – GENERAL**101. EXTENT

101.1 This section covers the requirements for CONTRACTOR furnished and installed:

- a. Adjustable blade vaneaxial fans
- b. Centrifugal fans
- c. Inline centrifugal fans
- d. Centrifugal roof and wall exhaust fans
- e. Wall mounted propeller fans
- f. Hooded propeller roof fans
- g. Reversible hooded propeller roof fans

102. RELATED WORK SPECIFIED IN OTHER SECTIONS

- 102.1 Section 230500, General Requirements for HVAC Systems
- 102.2 Section 230513, Common Motor Requirements for HVAC Equipment

103. DESIGN REQUIREMENTS

- 103.1 The design and performance of the fans shall meet the requirements shown on the drawings, equipment schedules and data sheets.

104. REFERENCE DOCUMENTS

- 104.1 Related standards, Specifications, manuals and/or other publications of nationally recognized organizations are referenced herein. Methods, Equipment and materials shall comply with applicable or specified portions of referenced documents, in addition to Federal, State or local Codes having jurisdiction.
- 104.2 References to these documents shall be to the issue date as adopted in IBC 2006. If the document is not referenced in IBC 2006, then the reference is to the latest issue date of the document together with the latest additions, addenda, amendments, supplements, etc. in effect on the date of contract award.
- 104.3 AMCA - Air Movement and Control Association:
  - a. 99 – Standards Handbook

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- b. 204 – Balance Quality and Vibration Levels for Fans
- c. 210 – Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
- d. 211 – Certified Ratings Program – Product Rating Manual for Fan Air Performance
- e. 300 – Reverberant Room Method for Sound Testing of Fans
- f. 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data
- g. 311 – Certified Sound Ratings Program for Air Moving Devices
- 104.4 ABMA - American Bearing Manufacturers Association:
  - a. 9 – Load Ratings and Fatigue Life for Ball Bearings
  - b. 11 – Load Ratings and Fatigue Life for Roller Bearings
- 104.5 ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers:
  - a. 90.1 – Energy Standard for Buildings except Low-Rise Residential Buildings
- 104.6 ASTM – ASTM International:
  - a. B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
- 104.7 OSHA – Occupational Safety and Health Administration:
  - a. 1910.212 – General requirements for Machine Guarding
  - b. 1910.219 – General requirements for guarding safe use of mechanical power transmission apparatus
- 104.8 UL – Underwriters Laboratories:
  - a. 507 – Electric Fans
  - b. 705 – Standard Power Ventilators
- 105. SUBMITTALS
- 105.1 Submit documents for review in accordance with the submittal requirements of this Specification.
- 105.2 Provide dimensional drawings and product data for each fan and included accessories.
- 105.3 Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted.
- 105.4 Provide outlet velocity of fans and both inlet and outlet sound power readings for the eight octave bands.
- 105.5 Provide fan mounting details, including method of attachment.

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- 105.6 Provide manufacturer's certification that fans are licensed to bear Air Movement and Control Association (AMCA), Certified Rating Seal for sound and air performance
106. GENERAL QUALITY CONTROL AND QUALITY ASSURANCE PROVISIONS
- 106.1 Fans shall be licensed to bear the AMCA certified ratings seal for both sound and air.
107. DELIVERY, HANDLING AND STORAGE
- 107.1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation.
- 107.2 Store materials in a dry area indoors, protected from damage, and in accordance with manufacturer's instructions.
- 107.3 Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer.
108. PROJECT/SITE CONDITIONS
- 108.1 Work shall be performed at the temperatures recommended by the product manufacturer.

**PART 2 – PRODUCTS**

201. ADJUSTABLE BLADE VANEAXIAL FANS
- 201.1 Acceptable Manufacturers:
- a. Howden Buffalo
  - b. Loren Cook
  - c. New Philadelphia Fan
  - d. PennBarry
  - e. Twin Cities
- 201.2 Components:
- a. Fans shall be adjustable blade vaneaxial fans.
  - b. Fans shall be Arrangement 9, V-belt driven with the fan wheel mounted on a separate shaft and bearings supported completely within an enclosed tube isolated from the high velocity air stream or Arrangement 4, having the fan wheel mounted directly on the motor shaft with the wheel and motor assembly enclosed entirely within the fan housing. The blade pitch angle of attack shall be individually manually adjustable when the fan is stopped.

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- c. Fans shall be tested in accordance with AMCA 210 and AMCA 300 test codes for air moving devices and shall be guaranteed by the manufacturer to deliver rated published performance levels. Fans shall be licensed to bear the AMCA certified ratings seal for both sound and air.
  - d. Fan housings shall be of welded one-piece construction. The housing seam shall be continuously welded and ground smooth. Inlet and outlet flanges shall be provided.
  - e. Fan housings shall be fitted with aerodynamically designed stationary straightening guide vanes on the air discharge side of the fan wheel. Vanes shall be welded to both the housing and the inner cylinder and act to straighten the swirling motion of the air downstream of the fan blades.
  - f. The fan wheel shall be of individually manually adjustable blade pitch design and shall consist of a hub and blade assembly aluminum alloy castings. The wheel shall have blades of airfoil shape designed with a variable hub ratio system to allow the selected fan to operate at the highest efficiency possible. The blade pitch angle shall be completely adjustable through a service access door located in the fan housing. It shall never be necessary to remove the fan from the system or remove any connecting ductwork to manually adjust the blade pitch settings. Blade angle markings shall be permanently stamped into each blade and a corresponding index mark shall be permanently stamped into the hub near the blade sockets. The fan wheel assembly shall be machined to the proper diameter so that blade tip clearance shall be within tolerance necessary to insure certified fan performance. The blade angle is to be factory set at the blade angle required to achieve the specified flow rate and pressure. This blade angle shall be indicated on the fan nameplate.
  - g. Bearings for Arrangement 9 fans shall be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for a minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum fan RPM. All bearings shall be provided with pre-filled factory extended lubrication lines fitted with grease fittings terminating at the housing exterior.
  - h. Arrangement 9 fans shall be equipped with a fixed pitch V-belt drive selected to operate at the required RPM. The V-belt drive shall consist of cast iron sheaves and anti-static conducting belts. Drives shall be selected with a 1.5 service factor based upon the required brake horsepower of the fan.
- 201.3 Source Quality Control:
- a. All fans with motors and drives shall be completely assembled and test run as a unit at the specified operating speed prior to shipment. Each wheel shall be statically and dynamically balanced in accordance with AMCA 204 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings.
  - b. All fans shall receive a final inspection by a qualified inspector prior to shipment. Inspection to include: fan description and accessories, balance, welding, dimensions, bearings, duct and base connection points, paint finish and overall workmanship.
- 201.4 Finish Requirements:

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- a. The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant. Aluminum components shall be unpainted.

- b. Paint shall exceed 1,000 hour salt spray under ASTM B117 test method.

202. CENTRIFUGAL FANS

## 202.1 Acceptable Manufacturers:

- a. New York Blower
- b. Chicago Blower
- c. Champion Fan
- d. Howden Buffalo
- e. Twin Cities

## 202.2 Components:

- a. Fans shall be tested in accordance with AMCA 210 and AMCA 300 test codes for air moving devices and shall be licensed to bear the AMCA certified ratings seal for both sound and air.
- b. Fans shall have a sharply rising pressure characteristic extending through the operating range and continuing to rise beyond the efficiency peak to ensure quiet and stable operation. Fans shall have a non-overloading design with self-limiting horsepower characteristics and shall reach a peak in the normal selection area. All fans shall be capable of operating over the minimum pressure class limits, as specified in AMCA Standard 99-2408-69.
- c. Fan housings shall be of heavy gauge, continuously welded construction. Discharge flanges shall be provided for duct connections. Housings shall be suitably braced to prevent vibration or pulsation. Housings shall have tapered spun, aerodynamically designed inlet cones or shrouds providing stable flow and high rigidity.
- d. Wheels shall be of the non-overloading type. Wheels shall have a precision spun, flat inlet cone to allow higher efficiencies over the performance range of the fan. Blades shall be airfoil-shaped. All hollow blade wheels shall be continuously welded around all edges. All wheels shall be statically and dynamically balanced on precision electronic balancers to a Balance Quality Grade G6.3 per AMCA 204 or better.
- e. Shafts shall be steel, accurately turned, ground, polished, and ring gauged for accuracy. Shafts shall be sized for the first critical speed of at least 1.43 times the maximum speed.
- f. Bearings shall be heavy duty, grease lubricated, spherical roller or adapter mounted anti-friction ball, self-aligning, pillow block type and selected for a minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum fan RPM.

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- g. Motor sheaves shall be fixed pitch. Drives and belts shall be located external to the fan casing and rated for 150% of the required motor HP.
- h. Accessories such as belt guards, weather covers, access doors, companion flanges, variable inlet vanes, outlet dampers, inlet boxes, shaft coolers, shaft seals, inlet screens, etc., shall be provided by the fan manufacturer.

## 202.3 Source Quality Control:

- a. All fans prior to shipment shall be completely assembled and test run as a unit at the specified operating speed or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced in accordance with AMCA 204 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings.

## 202.4 Finish Requirements:

- a. The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant.
- b. Paint shall exceed 1,000 hour salt spray under ASTM B117 test method.

203. INLINE CENTRIFUGAL FANS

## 203.1 Acceptable Manufacturers:

- a. Greenheck
- b. Loren Cook
- c. PennBarry
- d. Twin Cities

## 203.2 Components:

- a. Fans shall be tubular centrifugal inline fans.
- b. Fans shall be designed for maximum efficiency. Fans shall have a sharply rising pressure characteristic extending through the operating range and continuing to rise well beyond the efficiency peak to assure quiet and stable operation under all conditions. Horsepower characteristics shall be truly self-limiting and shall reach a peak in the normal selection area.
- c. Fans shall be tested in accordance with AMCA 210 and AMCA 300 test codes for air moving devices and shall be guaranteed by the manufacturer to deliver rated published performance levels. Fans shall be licensed to bear the AMCA certified ratings seal for both sound and air.

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- d. Housings shall be cylindrical and welded steel throughout. Inlets shall be fully streamlined. Housings shall be suitably braced to prevent vibration or pulsation.
- e. Wheel diameters shall be in accordance with the standard sizes adopted by AMCA Standard 2411-69 for centrifugal tubular type fans. Fan wheel sizes 122 and 150 shall have single thickness plate-type blades. Fan wheel sizes 182 and larger shall have die-formed airfoil blades designed for maximum efficiency and quiet operation. Blades shall be continuously welded to the back plate and wheel cone. The wheel shall be specifically designed for inline fans. Wheels shall be statically and dynamically balanced and the complete fan assembly shall be test balanced at or near the operating speed at the factory prior to shipment.
- f. Shafts shall be accurately turned, ground, polished, and ring gauged for accuracy. Shafts shall be sized for the first critical speed of at least 1.43 times the maximum speed.
- g. Bearings shall be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for a minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum fan RPM. Bearings shall be equipped with extended lubrication lines with grease fittings outside of the fan housing.
- h. Motor sheaves shall be fixed pitch.
- i. Inlet vanes, where specified, shall be of the external type for sizes 122 & 150 and nested for sizes 185 and larger. Inlet vanes shall be designed for economical, stable, and efficient air volume control at partial load conditions.
- j. When specified, accessories such as belt guards (standard or OSHA), weather covers, bolted or quick-opening access doors, inlet and outlet companion flanges, and other accessories as required by the application shall be provided by the fan manufacturer.

## 203.3 Source Quality Control:

- a. All fans shall be completely assembled and test run as a unit at the specified operating speed prior to shipment. Each wheel shall be statically and dynamically balanced in accordance with AMCA 204 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings.

## 203.4 Finish Requirements:

- a. The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant. Aluminum components shall be unpainted.
- b. Paint shall exceed 1,000 hour salt spray under ASTM B117 test method.

204. CENTRIFUGAL ROOF AND WALL EXHAUSTERS

## 204.1 Acceptable Manufacturers:

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- a. Greenheck
- b. Loren Cook
- c. PennBarry
- d. Twin Cities

## 204.2 Components:

- a. Roof and wall mounted exhaust fans shall be of the belt driven or direct drive centrifugal type.
- b. Fans shall be tested in accordance with AMCA 210 and AMCA 300 test codes for air moving devices and shall be guaranteed by the manufacturer to deliver rated published performance levels. Fans shall be licensed to bear the AMCA certified ratings seal for both sound and air.
- c. Fans shall be constructed of aluminum for durability and appearance. Fan spinnings shall have a rolled bead edge for rigidity. Units shall have a deep venturi inlet to prevent snow and rain entry into the building. The curb cap shall include prepunched mounting holes for ease of installation. A conduit chase constructed of electrical metallic tubing shall be provided to the motor compartment. The curb base shall have continuously welded corners for maximum leak protection. Lifting lugs shall be provided inside the motor compartment for ease of handling and installation. Fans shall bear a permanently attached nameplate displaying model and serial number of the unit for future identification.
- d. Motor assembly shall be mounted on vibration isolators to eliminate vibration and noise transmission into the ductwork. Motors shall be mounted out of the exhaust air stream and shall have a cooling tube that provides air separate from the exhaust.
- e. Fan wheels shall be of the centrifugal backward inclined type, containing a matching inlet venturi. Fan wheels shall be constructed of aluminum. Wheels shall be statically and dynamically balanced.
- f. Fan shafts shall be precision-ground and polished. Shafts shall have a first critical speed of at least 125% of the fan's maximum operating speed.
- g. Bearings shall be of the one-piece, pillow block type with relubricable fittings. Bearings shall be designed for air handling service with a minimum L-10 life in excess of 100,000 hours; L-50 200,000 hours at the maximum operating speed. Bearing mounting plate shall have self-aligning tabs for exact locating and alignment of bearings.
- h. Drive assembly shall be constructed of heavy-gauge galvanized steel. Drives shall be sized for a minimum of 150% of driven horsepower. Machined, cast iron motor sheaves shall be adjustable for final system balance.
- i. When specified, accessories such as backdraft damper, roof curb, curb hinge, retaining chain, security hasp, NEMA-4 disconnect switch, 2-speed switch, firestat, steel premium grease fan construction, aluminum bird screen, aluminum insect screen, and special coatings shall be provided by the fan manufacturer.



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## 204.3 Source Quality Control:

- a. All fans prior to shipment shall be completely assembled and test run as a unit at operating speed or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced in accordance with AMCA 204 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings.

## 204.4 Finish Requirements:

- a. Fans shall be constructed of aluminum.

205. WALL MOUNTED PROPELLER FANS

## 205.1 Acceptable Manufacturers:

- a. Greenheck
- b. Loren Cook
- c. PennBarry
- d. Twin Cities

## 205.2 Components:

- a. Fans shall be tested in accordance with AMCA 210 and AMCA 300 test codes for air moving devices and shall be guaranteed by the manufacturer to deliver rated published performance levels. Fans shall be licensed to bear the AMCA certified ratings seal for both sound and air.
- b. Propellers shall be cast aluminum alloy construction positively attached to the shaft to assure positive rotation. Propellers shall be machined to the proper diameter and statically balanced.
- c. Panel shall be constructed of heavy gauge steel with square flanged edges. A deep-throated orifice shall be provided for smooth, efficient airflow. Heavy gauge steel tubing shall support the motor and the shaft and bearing assembly.
- d. The rotating assembly shall be supported by two heavy-duty pillow block ball or roller type bearings. The bearings shall be of a self-aligning type and designed for a minimum L50 life of 200,000 hours based on AFBMA rating designations.
- e. The fan shaft shall be ground and polished, hot-rolled steel precisely turned and ring gauged for accuracy. The entire rotating assembly shall be designed to limits that insure the critical speed of at least 42% greater than the fan operating speed.
- f. The fan shall be equipped with fixed pitch V-belt drive for operation at the required RPM. V-belt drive shall be selected with a 1.5 safety factor based on the fan brake horsepower.

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- g. Accessories such as wire guards, wall box enclosures, power roof vent construction, etc., shall be provided by the fan manufacturer.

## 205.3 Source Quality Control:

- a. All fans prior to shipment shall be completely assembled and test run as a unit at operating speed or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced in accordance with AMCA 204 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings.

## 205.4 Finish Requirements:

- a. The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant. Aluminum components shall be unpainted.
- b. Paint shall exceed 1,000 hour salt spray under ASTM B117 test method.

206. HOODED PROPELLER ROOF FANS

## 206.1 Acceptable Manufacturers:

- a. Greenheck
- b. Loren Cook
- c. PennBarry
- d. Twin Cities

## 206.2 Components:

- a. Fan shall be a hooded, roof mounted, direct driven or belt driven, propeller fan.
- b. Fans shall be tested in accordance with AMCA 210 and AMCA 300 test codes for air moving devices and shall be guaranteed by the manufacturer to deliver rated published performance levels. Fans shall be licensed to bear the AMCA certified ratings seal for both sound and air.
- c. Propeller shall be extruded aluminum airfoil design with cast aluminum hub. The blade pitch shall be factory set and locked using set screws and roll pin. The hub shall be keyed and locked to the shaft utilizing two set screws or a taper lock bushing. Propeller shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration
- d. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor shall be mounted on a welded tubular steel power assembly. The power assembly shall be rigidly secured to the fan housing. The steel fan housing shall include a minimum 14 gauge base

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with integral spun venturi and continuously welded curb cap corners. The fan shall be enclosed with a minimum 18 gauge galvanized steel hood bolted to the fan housing. The hood shall have a removable top cap to allow unobstructed access to the motor and power assembly without removing entire hood. The fan outlet shall be protected from entry of foreign material by ½" x ½" galvanized steel screen.

## 206.3 Source Quality Control:

- a. All fans prior to shipment shall be completely assembled and test run as a unit at operating speed or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced in accordance with AMCA 204 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings.

## 206.4 Finish Requirements:

- a. The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant. Aluminum components shall be unpainted.
- b. Paint shall exceed 1,000 hour salt spray under ASTM B117 test method.

207. REVERSIBLE HOODED PROPELLER ROOF FANS

## 207.1 Acceptable Manufacturers:

- a. Greenheck
- b. Loren Cook
- c. PennBarry
- d. Twin Cities

## 207.2 Components:

- a. Fan shall be a hooded, roof mounted, direct driven, propeller supply / exhaust reversible fan.
- b. Fans shall be tested in accordance with AMCA 210 and AMCA 300 test codes for air moving devices and shall be guaranteed by the manufacturer to deliver rated published performance levels. Fans shall be licensed to bear the AMCA certified ratings seal for both sound and air.
- c. Propeller shall be a reversible, extruded aluminum airfoil design with cast aluminum hub. The blade pitch shall be factory set and locked using set screws and roll pin. The hub shall be keyed and locked to the shaft utilizing two set screws or a taper lock bushing. Propeller shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration

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- d. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor shall be mounted on a welded tubular steel power assembly. The power assembly shall be rigidly secured to the fan housing. The steel fan housing shall include a minimum 14 gauge base with integral spun venturi and continuously welded curb cap corners. The fan shall be enclosed with a minimum 18 gauge galvanized steel hood bolted to the fan housing. The hood shall have a removable top cap to allow unobstructed access to the motor and power assembly without removing entire hood. The hood shall be protected from entry of foreign material by ½" x ½" galvanized steel screen.

## 207.3 Source Quality Control:

- a. All fans prior to shipment shall be completely assembled and test run as a unit at operating speed or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced in accordance with AMCA 204 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings.

## 207.4 Finish Requirements:

- a. The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant. Aluminum components shall be unpainted.
- b. Paint shall exceed 1,000 hour salt spray under ASTM B117 test method.

**PART 3 – EXECUTION**301. GENERAL

- 301.1 Fans shall be installed in accordance with the manufacturer's instructions and shall be located to permit access after installation.

302. PREPARATION

- 302.1 Examine areas to receive fans. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected

303. ERECTION, INSTALLATION OR APPLICATION INCLUDING TRAINING

- 303.1 Installation shall be as shown and according to the manufacturer's diagrams, recommendations and manufacturer's installation instructions.
- 303.2 Install units as indicated, level and plumb, and according to Manufacturer's written instructions, the design drawings, and referenced standards

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303.3 Install connections, maintaining Manufacturer's recommended clearances for service and maintenance.

304. FIELD QUALITY CONTROL

304.1 Perform initial testing of the units in accordance with manufacturer's instructions.

304.2 Test the units in accordance with the requirements of Section 230593 Testing, Adjusting, and Balancing for HVAC Equipment and Section 230800 Commissioning HVAC Systems.

305. ADJUSTING AND CLEANING

305.1 Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction.

305.2 Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension.

305.3 Adjust fans to the speed indicated by the manufacturer to meet specified conditions.

306. PROTECTION

306.1 Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations.

307. RECORD DOCUMENTATION

307.1 Installation drawings shall be submitted. Drawings shall indicate overall physical features, dimensions, ratings, service requirements, equipment weights and layout and arrangement details of equipment room.

END OF SECTION